Municipality Moves SCADA System from Desktop Computers to Terminal Services

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ABSTRACT
One of the most time consuming tasks of updating a SCADA system can be simply copying the application to all of the servers and view nodes. The Region of Halton spent an average of 2000 person hours on application updates per year due to the high number of HMI workstations and servers across a wide geographical area. For instance, updating the water distribution application required copying the files to ten laptops and over a dozen workstations. When doing an update on that application the integrator would need to arrange to meet with all of the operators to update their laptops. This resulted in loss of time for the operators and the integrator.

In late 2013 the Region of Halton began to move their SCADA system from traditional Windows PC based ‘view nodes’ to thin clients using Remote Desktop Services. The change involved installing 18 new Terminal Services servers, replacing 80 Windows desktop PCs with Thin clients, and the integration of Thin Client management software. This presentation and paper will cover our business case for the migration, our experience during the upgrade, and the benefits and drawbacks of the project.

Introduction
The Halton Region spends an estimated two thousand (2000) hours per year updating the HMI applications throughout its eleven (11) water treatment and wastewater treatment plants and the water distribution and waste collection systems. Even seemingly small changes to a screen required copying the application to each server and workstation with the latest version of the HMI application.

Original Network Configuration
Although the Region’s network architecture is flat the following system hierarchy organizes the SCADA portion of the network:

1. Historian Servers;
2. Redundant Physical Servers for each HMI Application;
3. View Nodes consisting of laptops and regular workstations; and
4. OITs.

A sample network layout is shown below.
The heavy cost of deployment

The old standard operational procedure for deployment of the HMI applications was time consuming. Generally the procedure Region wide can be summarized in the following steps.

1. Compress current application from relevant server;
2. Copy current application to working machine;
3. Update application;
4. Compress updated application;
5. Copy updated application to Primary Server;
6. Archive current (and two legacy) applications on Primary Server;
7. Shutdown HMI Software with System Management Console;
8. Uncompress updated application;
9. Restart server;
10. Repeat steps (5) through (9) for the Secondary Server;
11. Repeat steps (5) through (9) for all View Nodes, replacing restart server with simply restarting HMI software.

Treatment Plants

The water/wastewater treatment plants consisted of redundant I/O Servers, 5-10 view nodes and at least one standby laptop. Making a change to the HMI application meant copying the application folder (100-250MB) to each server, workstation and laptop. This required some co-ordination as well to
ensure that the laptop was on site. In all at least 4 hours were spent when making any changes to an application at one of the plants.

**Water Distribution and Waste Collection**

The operators in the water distribution system carry laptops that have the HMI software running on it. They work in shifts which requires a considerable amount of co-ordination on the part of the integrator when deploying any changes to the HMI application. Updating the water distribution application requires at least one full eight hour day, even if the change being made is minor.

**Licensing costs**

The Region of Halton hired a consultant to complete a series of technical memorandums exploring the possible benefits and drawbacks. The report suggested that there were some potential savings in licensing cost by switching from per workstation licenses to concurrent licenses. Upon further investigation it was apparent that the cost savings will not be realized during or immediately after the conversion, but rather during any future expansion at the treatment plants or distributed systems. This is in part due to the cost of converting the licenses, and the higher cost of concurrent licenses. However when new workstations are required in the future, the Region will save costs on operating system licensing, HMI application licensing, and hardware costs. This would be achieved with a concurrent licensing system capable of supplying a larger number of serviceable computer terminals with fewer licenses. In the original system every View Node requires a license. For some facilities such as Oakville or Burlington Water Purification Plants this number ranges from 15 to 25 licenses. It was found that at any given time only a few computers are being used and only a small number of operators were ever using the SCADA system at a time (typically 4-6). With a Terminal Services deployment these facilities could potentially be serviced with 20 terminals, capable of viewing the entire SCADA system, all of which connect to a primary server for a view license. The license is only required while a terminal remains in use. This would allow plant staff to share a few licenses across dozens of machines.

**Other Benefits**

The minor benefits of a Terminal Services implementation that have been identified at this stage of the project include the following.

1. System security increased without local OS;
2. Potential bandwidth reduction;
3. Control room enhancements;
4. Casual user support;
5. Increased control at remote facilities;
6. Better access to multiple applications from one client; and
7. Faster response time for mobile users.
Increased System Security/Stability

The first security benefit is a potential reduction in theft which reduces the chance for valuable material to be stolen. If Thin Clients are installed on the plant floor the likelihood of theft would decrease. The average person will not have a use for a Terminal Services based device which is only capable of displaying information from a specific server. Without a potential use outside of the plant setting the likelihood of theft is reduced. As a terminal services implementation no data resides on the machine, not even an instance of the HMI software application or license. The client machine is effectively a view port into the application.

The second system stability benefit is achieved by the delivery of system updates. With Thin Clients, there is no need to regularly update (weekly) the operating system on the workstations.

Bandwidth Reduction

Prior to the conversion all data was streamed to every View Node even while they were not in use as the InTouch application software is configured to run as a service. This means that every tag, alarm enable, setpoint, control parameter and field feedback status and value are sent to every machine at regular intervals. A terminal services deployment means all communication take place solely between the I/O Server and Terminal Server. All view clients simply display the data as an image when requested to do so by an operator.

This has significantly reduced network traffic, as the clients are not be updating when not in use, and use much less data when they are in use. The lowered bandwidth usage is apparent immediately as shown in the graphs below. The results shown in the usage graphs were typical for all of the sites that were converted to terminal services.
Control Room Enhancements

The thin client platform the Region chose enables the use of multiple monitors with one thin client. This allows more information to be displayed to Operators and Management for effective and quick decision-making. We have installed dual and three monitor units in the control room at each of the plants and the operators are using them to display different parts of the plant on one screen, alarm screen on another, and in some cases trends on the third screen. The operator can move from screen to screen without having to change mouse and keyboards by moving the mouse from the edge of one screen to the next. This has proven to be the strongest feature in terms of client satisfaction and operators are looking at expanding to up to 5 monitors at some of the sites. Care must be taken when adding additional monitors because each of them requires a separate concurrent license. Our team took precautions to ensure that enough licenses were available in the event that one operator is in the control room working on the multi-monitor thin client, and another one was out in the plant.

Casual User Support

Before the upgrade casual users were challenging to support because of the deployment cost, both from a financial and a personnel perspective. With a terminal services deployment casual users can be added...
to the login roster to a given server and have immediate view only access with significantly reduced effort. This has helped a large number of Region staff expedite projects.

**Increased Control at Remote Facilities**

Currently there are remote facilities that have standalone OITs installed. These OITs require a standalone application that must be developed and maintained, this application comes at its own cost above HMI development costs. With Terminal Services implemented Thin Clients, using Industrial Touch Panel machines could be installed in place of all existing OITs. This would reduce the maintenance cost of updating special machines applications as well as the current HMI and will save on deployment time. In addition it allows remote sites to access the entire SCADA application and extend the control reach of field staff during emergencies and daily operations.

**Fallback strategy**

Redundancy of high importance within the SCADA system, and as such the deployment of View Nodes as part of the transition to a Terminal Services deployment strategy was desirable. Deploying a full workstation view node allowed us to bypass the Terminal Services server in the event of failure. One workstation running a full version of Windows and the HMI software is installed at each plant and will continue to get data by the traditional method from the I/O server. During a network outage or an Terminal Services server failure, process visualization would be preserved, provided the network failure is not between the View Node and the Polling Server. These nodes will remain, receiving process data from the Polling Server and historical data from the Historian. They still need to be updated when making changes to the HMI application, MS-Windows updates and other required upgrades typical to how the Region is currently completing these tasks.
Conclusion
The deployment of a Terminal Services based SCADA system has greatly benefited the Halton Region by reducing the cost of making changes to the HMI applications. It has also allowed us to apply more frequent changes and respond to the clients’ needs in a timely manner simply by not having to wait until there are enough changes to warrant updating all of the servers and workstations. It has decreased the bandwidth required at all of our treatment plants and remote facilities while improving the apparent performance of the HMI application from the operators’ viewpoint.

List of Acronyms:
HMI ................... Human Machine Interface
SCADA .............. Supervisory Control and Data Acquisition
OIT .................... Operator Interface Terminal
PC ..................... Personal Computer
I/O .................... Input/Output
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